

Claims

We claim:

- 1 1. A light sensor comprising:
 - 2 a set of light emitting diodes, each light emitting diode configured to
 - 3 emit a corresponding wavelength such that at least one wavelength of one
 - 4 light emitting diode is different than one other wavelength of another light
 - 5 emitting diode; and
 - 6 a microcontroller, comprising:
 - 7 a plurality of pairs of I/O pins, there being one pair of I/O pins
 - 8 connected to one corresponding light emitting diode;
 - 9 means for selectively driving a first subset of the light emitting
 - 10 diodes in a reverse bias to charge a capacitance of the first subset of
 - 11 light emitting diodes; and
 - 12 means for measuring a time for the capacitance of each of the
 - 13 first subset of light emitting diodes to discharge due to photocurrent
 - 14 induced by incident light on the first subset of light emitting diodes,
 - 15 the time being inversely proportional to an intensity of the incident
 - 16 light.
- 1 2. The light sensor of claim 1, in which the incident light is ambient natural
- 2 light.
- 1 3. The light sensor of claim 1, in which the incident light is emitted by an
- 2 external light source.

- 1 4. The light sensor of claim 1, further comprising:
2 means for selectively driving a second subset of the set of light
3 emitting diodes in a forward bias to emit light at the corresponding
4 wavelengths, while driving the first subset of light emitting diodes in the
5 reverse bias so that the incident light is emitted by the second subset of light
6 emitting diodes.
- 1 5. The light sensor of claim 1, further comprising:
2 a capacitance connected in parallel with each light emitting diodes.
- 1 6. The light sensor of claim 1, in which the means for measuring uses a logic
2 level threshold of the microcontroller.
- 1 7. The light sensor of claim 1, in which the means for measuring includes a
2 interrupt service procedure.
- 1 8. The light sensor of claim 1, in which the means for measuring includes a
2 polling procedure.
- 1 9. The light sensor of claim 1, in which the means for measuring includes a
2 clock of the microcontroller.
- 1 10. The light sensor of claim 1, in which the capacitance is a parasitic
2 capacitance inherent in the light emitting diodes, the microcontroller I/O
3 pins, and connective wiring.

1 11. The light sensor of claim 10, in which the parasitic capacitance is about
2 twenty picofarads.

1 12. The light sensor of claim 1, in which the capacitance is charged by
2 configuring the corresponding I/O pins in output mode.

1 13. The light sensor of claim 1, in which the capacitance is discharged by
2 configuring the corresponding I/O pins in input mode.

1 14. The light sensor of claim 13, in which an impedance of the
2 corresponding pins configured in the input mode is greater than a million
3 Ohms.

1 15. The light sensor of claim 1, in which the means for measuring produces
2 directly a pulse-width-modulated logic-level signal with a width of the pulse
3 being inversely proportional to the intensity of the incident light.

1 16. The light sensor of claim 1, further comprising:
2 a test material to reflect the incident light.

1 17. The light sensor of claim 4, further comprising:
2 a test material to transmit the incident light.

1 18. The light sensor of claim 16, in which a surface of the test material is
2 placed at a perpendicular angle with respect to the incident light to measure
3 specular reflectance.

1 19. The light sensor of claim 16, in which a surface of the test material is
2 placed at an oblique angle with respect to the incident light to measure
3 diffuse reflectance.

1 20. The light sensors of claim 4, further comprising:
2 means for alternating the driving of the first subset of light emitting
3 diodes and the second subset of light emitting diode in the reverse and
4 forward bias.

1 21. The light sensor of claim 1, in which the incident light includes ambient
2 light and light from a light source, and further comprising:
3 means for measuring a difference between an intensity of the ambient
4 light, and an intensity of the light from the other light source to enable a
5 differential measuring of the intensity of the incident light.

1 22. The light sensors of claim 4, further comprising:
2 means for continuously driving the first subset and the second subset
3 in the forward and reverse bias, respectively.

1 23. The light sensors of claim 1, further comprising:
2 means for selecting the light emitting diodes in the first and second
3 subset by a pseudo-random sequence; and
4 means for averaging the measured times while selecting according to
5 the pseudo-random sequence.

1 24. The light sensor of claim 4, in which the wavelengths of the first set of
2 light emitting diodes is less than or equal to the wavelengths of the second
3 set of light emitting diodes.

1 25. The light sensor of claim 1, further comprising:
2 a test material placed between the incident light and the first subset of
3 light emitting diodes so that the incident light passes through the test
4 material to measure the intensity of the incident light transmitted through the
5 test material.

1 26. The light sensor of claim 24, in which the test material is placed at a
2 perpendicular angle with respect to the incident light.

1 27. The light sensor of claim 24, in which the test material is placed at an
2 oblique angle with respect to the incident light.

1 28. The light sensor of claim 24, in which the test material is translucent.

1 29. The light sensor of claim 24, in which the test material is opaque.

1 30. The light sensor of claim 4, in which a test material is placed between a
2 reflector and the first and second sets of light emitting diodes.

1 31. The light sensor of claim 28, in which the test material is at a
2 perpendicular angle with respect to the incident light.

1 32. The light sensor of claim 28, in which the test material is at an oblique
2 angle with respect to the incident light to measure turbidity within the test
3 material.

1 33. The light sensor of claim 4, in which the second set of light emitting
2 diodes emit ultraviolet light as the incident light.

1 34. The light sensor of claim 31, in which the incident light is reflected from
2 a fluorescent test material to the first set of light emitting diodes.

1 35. A method for sensing incident light, comprising the steps of:
2 selecting a set of light emitting diodes having corresponding
3 wavelengths such that at least one wavelength of one light emitting diode is
4 different than one other wavelength of another light emitting diode; and
5 selectively driving a first subset of the light emitting diodes in a
6 reverse bias to charge a capacitance of the first subset of light emitting
7 diodes; and
8 measuring a time for the capacitance of each of the first subset of light
9 emitting diodes to discharge due to photocurrent induced by incident light on
10 the first subset of light emitting diodes, the time being inversely proportional
11 to an intensity of the incident light.

1 36. The method of claim 33, further comprising:
2 selectively driving a second subset of the set of light emitting diodes
3 in a forward bias to emit light at the corresponding wavelengths, while
4 driving the first subset of light emitting diodes in the reverse bias so that the
5 incident light is emitted by the second subset of light emitting diodes.

1 37. The method of claim 33, in which a test material reflects the incident
2 light.

1 38. The method of claim 33, in which a test material transmits the incident
2 light.

1 39. The method of claim 34, further comprising:
2 placing a test material between the first set and the second set of light
3 emitting diodes.